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## GENERAL REVIEWS AND SUMMARIES

### TASTE AND SMELL

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The last year has brought no epoch-making contributions either to the psychology or to the physiology of smell and taste. Larguier des Bancels (6) makes an excellent transcript of the sum of knowledge in regard to smell, a transcript which is the counterpart of his recent paper on taste (6). Sternberg (7) writes rather discursively on the perception of differences in taste and smell. The differences which he has chiefly in mind are the gross differences between the four taste qualities and between such smells as valerian and pyridin. He has experimented upon cats, upon a human anencephalus, upon some suckling infants, upon twelve children between eight and fourteen years of age, four blind, four deaf-mutes, and four normal, and upon certain sick children and adults. The experiments were probably performed by clinical rather than by academic methods for the writer gives no details of procedure aside from mentioning the materials and instruments used. His vapor gustometer and olfactometer are of interest. Cuts are included in this paper. The writer holds that the mechanism for sharply different reactions to different tastes is established in the human fœtus before birth. Indeed, the anencephalus reacted very differently to sweet and bitter. The lack of sight or hearing seems to better the differential sensitivity for taste and smell. Cats are highly sensitive to taste and smell differences. Sensitiveness to taste differences is heightened in gastric disorders.

Becher (1), who, in connection with an investigation of the physiological effects of alcohol, has recently studied fifty persons over

ninety years of age, reports two cases in which aged women showed an abnormal desire for sweet as compared with unsweetened foods. In one case, even bouillon was taken only when sweetened with cane sugar. Becher believes that we have here a hyperæsthesia for salt, sour and bitter tastes and a desire for sugar as a corrective. This senile hypergeusia he believes to be rare but to be akin to the hypergeusia of hysterics and neurasthenics, to senile pruritus, and perhaps also to pathological *libido senilis*. Urbantschitsch (**8**) has studied in thirty cases the effect of unilateral inflammation of the middle ear upon keenness of smell on the affected side of the head, taking the keenness of the other nostril as a standard. He used five kinds of odors (not named). In some cases, sensibility was impaired for all the odors on the side of the diseased ear, but in other cases it was heightened, whereas in still others it was heightened for some odors but impaired for others. The writer concludes that suppuration in the middle ear is sufficient to produce disturbances of smell without otogenous abscess in the temporal lobe as an intermediary.

Hopf and Edzard (**5**) have studied the distribution of the lingual papillæ in different human races and in apes. Their subjects comprised seven negroes, five Melanesians, one Javan, and three Japanese, six gibbons, one orang, and one chimpanzee. No striking differences were observed in either the fungiform or the filiform papillæ or in the number of circumvallate papillæ. Certain slight racial differences did appear in the arrangement of circumvallate papillæ. In this regard, the Melanesians and gibbons departed most widely from the Caucasian, human type. No very definite findings in regard to foliate papillæ were made.

Botezat (**2**) has made an extended study of the taste organs of birds,—sparrows, linnets and water-rails. The taste-buds of birds resemble in structure those of man, but are often different in shape, are not found on definite papillæ, and occur mainly in the throat, although they appear also in the forward part of the mouth cavity except on the tip of the tongue and the forward part of the hard palate. They are of two sorts, independent buds, which occur in groups both in ordinary and in glandular epithelium, and gland buds, which are found about the mouths of glands, one, two, or three to a gland. The functional importance of both kinds of buds is probably slight, but whereas the independent buds correspond to the taste buds of the lower vertebrates and to the ordinary taste buds of mammals, the gland buds are the forerunners of the more sensitive buds about the circumvallate papillæ of the higher mammals.

In ascending the scale of vertebrates, the area over which the taste buds are distributed diminishes, and in the mouth cavity, with the disappearance of the buds, comes a furrowing of the epidermis and a formation of corium papillæ which, in the higher mammals, are in part tactile in function. Gawrilenko (4) has studied the development of the smell organ in the salmon trout. Of interest are the descriptions and plates which exhibit the doubling of the olfactory pouch on each side, a doubling which corresponds to the division of olfactory nerve fibers. The medial half of the pouch is the original of Jacobson's organ; the lateral half is the forerunner of the olfactory membrane in mammals.

Von Frey (3) proves abundantly by experimental data that the 'alkaline taste' is really an alkaline smell. He shows that it is due to the liberation by the alkaline substance of the volatile base, methylated ammonia, which is formed from the decomposition products of the buccal epithelium and is found in ordinary but not in freshly secreted saliva.


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## CUTANEOUS, KINÆSTHETIC AND MISCELLANEOUS SENSES


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During the year 1910, v. Frey (7) published a short review of work on the physiology of the cutaneous sense organs, beginning

with that of E. H. Weber, and Kiesow (9) prefaces his preliminary report on reaction times to cutaneous pain by a twenty-page account, admirably written, of the development of our knowledge of pain sensations since the time of J. Müller and E. H. Weber.

*Cutaneous Sensations.*—Baglioni and Tamburini are concerned with the existence of a specific electrical sense. Tamburini (16), on purely introspective grounds (*e. g.*, that the contact of two electrodes with the skin gives, when the current passes, a sensation qualitatively different from that obtained with no current), affirms the existence of a special electrical sense, even although evolution has not yet developed special terminal organs. Baglioni (1), working under more rigid experimental conditions, concludes that there is no elementary electrical sense but that the faradic current is an inadequate stimulus for touch and pain and, agreeing with a previous statement of v. Frey, for temperature organs. He first found that the degrees of sensibiltiy to faradic stimulation for the regions studied correspond with those for touch proper in the same regions. On then testing the dorsal surface of the glans penis, which v. Frey had found insensitive to touch, he evoked a pain sensation at 10 volts, sensing nothing at all similar to touch. Some of the results for other portions of the body were: *tip of tongue*, touch ('formicolio'—slight prickly sensation) at .5 volt, pain at 7 volts; *inside of upper lip*, touch at 4, pain at 9 volts; *back of hand*, touch at 25 volts, and prickle ('puntura') at 30 volts. The faradic current of low intensity excites, therefore, the touch and, of higher intensity, the pain organs.

The year yields two investigations on the spatial distribution of sensitive points in the skin. Franz (6) determined touch thresholds for selected points in representative bodily areas on five women subjects, four normal and one a neurological case. Bloch's instrument was used. For the detailed results one must consult the original article, where tables for the thresholds of each subject are given and also a comparative table showing the gradings of sensitivity for the various areas. Elo and Nikula (3) plot a topography of thresholds for warmth. Each experimented on the other, the leg of one being investigated and the trunk, arm, neck and head of the other. They used the flattened lower end of a thermometer, covering a skin area of about ½ sq. cm., as the stimulating surface. The bulb, just above this flattened surface, was wound with insulated wire, connected with resistances, so that any desired temperature could be obtained and easily read off from the thermometer itself. In order to avoid the actual handling of this thermometer-stimulus, a wooden

handle projected at a right angle from it. Each application of the stimulus lasted about 1 second. The experiment room was kept at a constant temperature of 22° C. Only hairless areas were stimulated and those portions of the body usually covered by clothes were exposed only while being tested, since it was found that when the leg, for instance, became adapted to the air, the thresholds were lowered. In some cases a given threshold obtained for only a small area, in other cases for a much larger area. For points directly over a bone with little flesh covering higher thresholds obtained than for immediately adjacent fleshier points. Some idea of the spatial distribution of thresholds may be obtained from the following figures, all of which indicate degrees Centigrade: face, 31°–37°; neck, 24°–33°; breast, 30°–32°; abdomen, 34°; about anterior pelvis, 36°; back, 30°–33°; arm (upper), 28°–31.5°; forearm, 31.5°–33°; leg (inner upper), 30°–33°; outer upper, 32°–34°; inner lower, 33°–35°; outer lower, 32°–35°.

Allied to these topographical investigations are those of Franz, and Baglioni and Pilotti. Franz[1] (4) recurs to the problem of cutaneous sensations following nerve division, previously investigated by Head, Rivers and Sherren. In Franz's subject (a male nurse, an intelligent and careful observer), through a cut, the ulnar nerve had been divided, the median nicked and the medial antibrachial probably severed. The main examination for sensibility began about two months after the suturing of the divided ulnar. Head, Rivers and Sherren having found three different types of sensibility which, in general, might be separately lost or recovered,—*deep* sensibility (pressure, movement of parts, etc.), *protopathic* sensibility (cutaneous pain, extremes of heat and cold) and *epicritic* sensibility (light touch, moderate temperatures),—inferred that there are three independent systems of nerve supply and not merely an overlapping of areas of supply from the same system. In general Franz verifies these findings. He found hairs insensitive to traction, for instance, when still sensitive to light brushing, a fact in accord with the finding of a twofold nerve supply to the hairs. This is not to be explained by mere variation in threshold, since the traction stimuli were intenser than the brushing. The results from temperature stimulation also warrant the assumption of different nerve supplies for extreme (protopathic) and mean (epicritic) temperatures respectively. Although, for instance, extremes of temperature on areas not responsive to mean temperature evoke the responses 'cool' or 'warm,' the explana-

[1] Part of the material of this article appeared in the *Jour. of Comp. Neurol. and Psychol.*, 1909, **19**, 107–123.

tion cannot lie in mere threshold differences, since in some areas sensitivity to extremes is lost but that to means retained. Here, therefore, as above in the case of hair sensibility, the criticism generally made of the results of Head and others (that they are all explicable by merely assuming differences in threshold) cannot be upheld. Franz is inclined, however, to assume more extensive overlapping than his predecessors. He found, for instance, in testing the area intervening between an area of total loss of sensibility and that of normal sensibility, a gradual lowering of the threshold from the former to the latter. This implies an overlapping of nerve supply.

The work of Baglioni and Pilotti (**2**) concerns spatial and temporal order of disappearance (or reappearance) of the various forms of cutaneous sensibility under the influence of stovaine. The complete anæsthesia spreads gradually over the lower extremities, following an areal order *strictly corresponding to the order of arrangement of the fibres of the sensory spinal roots in relation to the point of stovaine injection.* It appears, therefore, that the stovaine affects these root fibres rather than the central paths in the cord, acting as a 'Blockadeerscheinung.' Secondly, the four cutaneous senses, for any given region of the skin, do not disappear at the same time; pain goes first, cold next, then warm, and finally pressure. Physiologically this is more difficult of explanation, if one assumes qualitative identity in the nervous impulses of the various afferent fibres. The authors are therefore inclined to assume that this differential effect of the anæsthetic on the various fibres indicates that the nerve impulses are not qualitatively identical,—an argument in support of Hering's theory of nervous activity. The order of return of sensibility in both the foregoing instances is the reverse of that of disappearance. Further, for a given quantity of stovaine, there is a differential spread of the four types of sensation, complete anæsthesia existing for a certain region but, beyond, only analgesia. Perhaps as interesting as any of the authors' facts is a striking demonstration of a paradoxical sensation of warmth, — a phenomenon not observed in the normal subject. Between the time of disappearance of sensitivity to cold and that to warm stimuli (or between their respective reappearances) the application of a vessel (30 mm. diameter) containing ice evoked the sensation warm.

Somewhat allied to this investigation is that of Franz and Ruediger (**5**) on sensory changes following the application of ethyl chloride. An area on the forearm, 5 cm. square, was marked off. The central part was sprayed with ethyl chloride until freezing set in, frost appear-

ing on the surface. This inner area was then tested during different stages of the chloride effect, and compared with the surrounding normal area. Ethyl chloride was found to be an analgesic and an anæsthetic. The latter effect was, however, shorter in duration than the former. Sensations of light touch, from slightly brushing the hairs, recurred very soon, while those of pressure and pain, from pulling the hairs, were absent for a longer period. These facts, like the similar phenomena recorded above on cutaneous sensitivity after nerve division, indicate two distinct sensory end organs for the hairs, contradicting the assumption that pulling sensations are merely the exaggeration of the touch-like sensation obtained by light brushing. Forthermore, pain from hair traction returns sooner than pain from pressure, a fact again indicating two separate end organs for these two types of stimuli.

Voigt (18) has studied in a preliminary way temperature judgments under the influence of adaptation. Three vessels, each containing about 3¾ litres of water were used. The left hand was immersed in vessel no. 1 and the right in vessel no. 2 as far as the knuckles. The water in vessel no. 2 differed in temperature from that in vessel no. 1 by 5° or 10° C. Immersion continued for from nine to fifteen minutes, special control experiments having shown that the degree of adaptation did not alter, whether the hands were kept in the water two minutes or seventy minutes. After adaptation both hands were plunged into vessels 2 and 3 respectively, the left in vessel no. 2 and the right in vessel no. 3. The subject was then asked whether the temperature in vessel no. 3 (for the right hand) was greater or less than, or equal to, that in vessel no. 2 (for the left hand). If adaptation had been complete for both hands, *i. e.*, so that the temperatures for vessels 1 and 2 felt alike at the end of the adaptation time, then a temperature difference between vessels 3 and 2 equal to that between vessels 2 and 1 should be felt as equal for both hands. This, however, never happened,—the ratio of the difference between temperatures in vessels 2 and 3, *when felt as equal*, to the difference between those of vessels 1 and 2, ranged from .1 to .25, instead of 1.0, which it would have been had the adaptation been complete. It appears thus that the degree of adaptability of the temperature organs in the hand is very small, and never as high as a fourth of complete or ideal adaptation.

Moore (11) reports on the adaptive influence of temperature and the electric current on skin sensibility. For temperature a hot water bag was placed on the volar surface of the forearm. The temperature

of a thermometer placed between the bag and the arm was taken as the arithmetical mean between the two. The sensitivity was determined by a series of v. Frey's hair æsthesiometers. The threshold for touch was lowered, under adaptation, up to a (calculated) skin temperature of 35°–38° C. For higher temperatures it rose again. As for electricity Moore found that the *direct* current decreases sensibility at the anode and increases it at the cathode, except for very strong or very weak stimuli, when the effect is doubtless concealed by the creeping of the anodic effect towards the cathode or vice versa. These phenomena are analogous to Pflüger's law of irritability in muscle. The *induced* current, immediately after application, lowers skin sensibility for touch and pain and a touch spot was found under these conditions to be transformed into a pain spot. In discussing the significance of these results the author points to the close parallelism between the temperature for maximal sensibility and that for maximal dissociation in bodily tissues, as well as to that for the maximal irritability in muscle. He concludes: "The maximum sensibility for touch and the maximum for muscular irritability are both found at the temperature of the greatest dissociation" (p. 374). The diverse functions of muscle, nerve, and sensory end organs appear, therefore, to be dependent upon one and the same chemical phenomenon.

Weber (19), with a different end in view, likewise tests the influence of temperature on touch sensibility. The forearm was warmed in heated air. For about six minutes after warming, as long, in fact, as the arm *felt* warm, sensibility diminished, but then increased, the increase persisting for 15 minutes or more. The preliminary decrease in sensibility was probably due to the effect of the temperature on the nerve endings themselves. When this passed off the dilative effect of the heat on the capillary blood vessels of the skin (arterial hyperæmia) became manifest in the lowering of the threshold for touch. The conditions of the experiments involved fixed attention by the subject to the area touched and, in order to accentuate and direct this, a preliminary stimulus markedly above the threshold was applied. Plethysmographic tests were then made to find whether the concentration of attention on a definitely localized skin area itself resulted in an increase of peripheral blood supply to that area. Among other tests, both arms of a normal subject were inserted in plethysmographs, the record being taken, however, for one arm only. In order to fixate attention, slight vibrations of the table were made, which were felt by both arms. Whenever the arm for which records

were taken was attended to there followed an increase in the blood supply and a decrease when the other arm was attended to. Such results certainly serve as a warning that the direction of attention is a powerful influence in determining experimental results.

Before closing the account of cutaneous sensations reference may be made to a preliminary article by Kiesow (9), already mentioned in another connection, which concerns reaction time, however, more than sensation. Two articles by Sternberg, on tickling and itching sensations may be passed over lightly. In one (13) he makes the tickling in the mouth by solid foods an essential part of our craving for such foods, creating an irresistible call for the energetic filling of the stomach with solids. He sees in this the reason why men could not go long on liquid food, and why babies suddenly begin to crave it. In the other article (14) he sees no reason for distinguishing between tickling and itching sensations, the difference being merely external; the former is the sensation when we are intentionally stimulated, the latter when a stimulus is inner or unknown. One is evoked actively, the other passively. He denies that subjective attitude plays an essential part in tickling, as well as the supposed fact on which such assumption is based (*i. e.*, that one cannot tickle himself), for if one runs the tip of the tongue or finger lightly from back to front on the roof of the mouth, one gets intense tickling sensations.

*Organic Sensations.*—Ritter (12) shows that a dog, narcotized with morphine, shows marked pain reactions when the viscera are stimulated. The contrary results of earlier investigators are doubtless due to the injury of the finer sensory fibres resulting from their extensive laparotomy or from long exposure of the viscera to air, which invariably decreases sensibility. Ritter made only small incisions and tested immediately but a small portion of exposed tissue. The vascular tissue is the most sensitive, except the mesentery. He is inclined to think this sensibility to pain also characteristic of human beings, partly as the result of experiments on six such subjects. Torata (17) found no reactions in an animal under strychnine to touch or cutting, from the heart or other inner organs; since strychnine causes tactual hyperæsthesia in the external skin, he concludes that the sensitivity of the internal organs is essentially different from that of the external. Without strychnine the heart, the stomach and the beginning of the intestine, subjected to cutting and chemical stimuli, caused responses. Miller (10) finds that a warm mustard solution, introduced directly into the stomach of an anæsthetized cat, causes vomiting and that the *vagi* are the afferent nerves concerned. Haudek

and Stigler (8), by means of the Roentgen ray, found that the stomach is emptied more rapidly after a meal eaten with relish ('Esslust') than when it is not. He makes no causal inferences. Sternberg (15) disagrees with Pawlow's assumption that appetite is the correlative of the secretion of juices in the mouth and stomach since (1) other things may occasion such secretions, (2) appetite is accompanied by other physiological phenomena and (3) these secretions, otherwise stimulated, do not occasion appetite.

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## SYNÆSTHESIA

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In the course of presenting some of the abnormal and unusual features of adolescence, Lemaitre (3) devotes two chapters (pp. 15–74) to his findings in respect to synæsthesias. No unusual varieties are reported, though, naturally, the cases cited are not without individual interest. Photisms of one variety or another and more or less extensive in character are found, it is claimed, in about one-fourth of adolescents. The period seems, however, to be critical for these states, about one-half losing by the age of fifteen of sixteen the previously possessed photism or other form.

From an examination of thirty-seven cases of colored hearing a table is compiled (p. 23) showing the distribution of colors in respect to the vowels. The tabulation—useful only as a basis of comparison with similar collective accounts, and then only when it is remembered that the French sounds of the vowels are in question—shows "that *a* is usually red or white, that *e* is yellow, that *i* is white, that *o* is black, that *u* is blue with a leaning towards the green or the yellow."

The second of the two chapters devoted to synæsthesias recalls, and in some particulars completes, three cases described by the author in 1901, in a volume entitled *L'audition colorée et les Phenomènes connexes*.

Mercante (4) is also concerned with the distribution of synæsthesias among children and adolescents. Examining upwards of 900 pupils of both sexes, he finds that about 80 per cent. (the girls somewhat in excess of the boys) present some form of chromæsthesia. Such experiences the author regards as quite normal for the ages between 8 and 18. A marked concordance in the coloration of the vowels, and of certain words, leads the author to believe that the chromæsthesias develop through the presence of a common affective ground, the given vowel and the associated color being both natural and usual excitants of the same emotional tone.

Ferrari (2) reports a case of 'gustatory audition' communicated to him by a young doctor of science who was himself the subject. The hearing of proper names and ordinary nouns evokes tastes and

odors. Examples are given, but no data are accessible for interpreting the origin or development of the associations.

So far as the present writer is aware, this is the third case of this variety of synæsthesia to be reported. In 1907, only two months after my own report of a similar case, Ferrari published in the *Rivista* an extended account of the experiences of a young woman, Nerina U. Taste, smell, and food equivalents were given for two hundred proper names, which alone seem to have evoked the experience. In general Ferrari's case agrees with my own. It differs from it, however, (1) in that odor equivalents are present (my own subject was anosmic), and (2) in not revealing the wide range of response to sounds of all sorts. It is interesting also to note that Ferrari's subject, while not presenting a serious defect, showed idiosyncrasies of taste and smell, preferring bitter to sweet and being fond of odors (like that of petroleum) which are usually disliked. This case seems to be so little known that its mention here may, perhaps, not be out of place.

Miss Downey (1) relates a case of colored gustation found in a young man with a somewhat defective sense of taste. The taste-colors, which were clear and precise, "were definitely localized in the mouth, where of hallucinatory vividness, and had a uniform color-tone and persistence under constant conditions." The localization of the color in the mouth, while here not unnatural, is not unique, the present writer having recently found a similar localization in a case of colored hearing.


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## AFFECTIVE PHENOMENA—EXPERIMENTAL


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The most extensive publication of the year was that of Weber (7). He studied the arm volume by means of the Lehmann plethysmograph. The volume of the ear was recorded by a capsule which fitted over

the ear and was connected to the registering apparatus. Changes in the abdominal vessels were tested with a small rubber bag inserted into the rectum and weakly inflated. Weber states that mental work, strain and shock gave a fall of volume of the arm and ear, and an increase in volume of the abdomen. Changes of level in the ear were more abrupt than those in the arm. Agreeable feelings and agreeably-toned emotions are said to be accompanied by rise of volume of the arm and ear and fall of volume of the abdomen; disagreeable states show opposite effects. A part of the stimuli for these results consisted of agreeable or disagreeable tastes, noises and problems; but most of the supposed effects were due to suggested stimuli during hypnotism. A stimulus will cause some reaction even as an unconscious process, but Weber believes that the suggestion in consciousness is the primary factor.

Electrical stimulation of different parts of the motor cortex of animals gave a rise of blood pressure, fall of volume of the abdomen and the ear, due to active constriction, and rise of volume of the extremities, due partly to active dilation. The use of this reaction is to send blood from the abdomen to the muscles concerned. The part of the motor cortex effective in different animals varies with the muscle-group most concerned in the mode of life of the animals. Similarly, Weber asserts, voluntary movement, or an idea of movement without actual movement, leads to rise of blood pressure, fall of volume of the ear and the abdomen, and rise of volume of the extremities, especially of the member most concerned in the intended movement. Many of these results were obtained during hypnotism.

Weber attempted to test these statements as to blood distribution by means of the Mosso balance. But he improved the method by making the board longer, and balancing the subject with the abdominal organs first on one side of the axis, then on the other. The movement of the writing-point was opposite in the two cases. Hypnotic suggestion was used again. The statement is that with ideas of movement, agreeable conditions, and sleep, the centre of gravity tends to leave the abdomen (the side on which it is placed becoming lighter); with other processes one gets the opposite result. The author obtained three curves, showing the influence of disagreeable stimuli upon the brain circulation. They are much obscured by movement, but he draws the conclusion that there is a decrease of volume and size of pulse.

The innervation of the cerebral vessels was studied by recording the arterial pressure and the brain volume in animals. After section

of the cord, or destruction of the general vasomotor centre, Weber stimulated the cortex and the possible nerve supply to the brain, and the conclusion is reached that the brain vessels are independent of the centre in the medulla, but are controlled by a separate centre centralwards from the medulla. The two hemispheres respond alike.

The author does not accept entirely the Lehmann-Berger theory of feeling. Particularly, he finds that with disagreeable stimuli, the cerebral vessels constrict at once in order to prevent too violent dissimilation; the peripheral vessels constrict in order to lower the sensitivity of the nerve terminals to the disagreeable stimulus.

It is difficult to evaluate the work of Weber. We certainly cannot accept results under hypnotism, especially when we know practically nothing of the relation of hypnotism to the circulation. His curves are often too short and many of them seem to be entirely ruined by movement. The results on cerebral innervation are suggestive. But as to the feelings, there are no adequate introspections, too few results, and the work is in no way comparable with several others that have appeared.

A controversy between Weber (8) and Berger (2) leads to the statement that disagreeable sensations often cause vasoconstriction in the brain. Berger (1) found that mental work caused some rise of temperature in the brain; the shock of a sudden noise caused a much delayed and smaller rise. The whole method is doubtful and the discussion very speculative.

After an excellent review of the literature of the last ten years, Kelchner (4) considers the following points reasonably well established: (1) The organic accompaniments of the feelings in the circulation and in the breathing are not on the same plane; in the latter, voluntary as well as reflex and automatic modifications must be considered. (2) The vasomotor changes are not primary in relation to the other organic changes. (3) The reactions are in part central, in part subcortical. Subliminal stimuli during sleep, narcosis, and hypnosis are not without effect; and there seems to be a dependence of certain reactions upon the kind of stimulus. (4) The emotional organic reactions are determined by the total psychophysical disposition. (5) The organic reactions are, at least in part, of significance for the functioning of the central organs. (6) It has not been shown that there is a delay of the expression after the feeling. (7) No observation contradicts the fundamental ideas of the peripheral theory of feeling.

Dumas and Malloizel (3) have shown that sexual excitement and

anger cause increased salivary, renal, and gastric secretions. Fear was more ambiguous in its effects.

Wells (9) tested the affective character of colors with a large class of students. The spectrum was divided into twelve hues. These were painted upon two-inch squares, mounted upon neutral gray, and numbered. The subjects were asked to designate the mood suggested by the color. Crimson, scarlet, deep orange, orange-yellow, and yellow were dominantly exciting. The middle region of the spectrum was tranquilizing. Violet-blue, violet, and purple were especially depressing. The different replies for the middle, tranquil region were often contradictory; those for the extremes were quite uniform as to exciting or depressing character. It is noteworthy that these characters persisted whether the subject liked or disliked the color. Scarlet was always exciting, whether it was called cheerful or loud.

Taylor and Washburn (6) obtained the affective reaction of a number of students to logical fallacies. The sources of unpleasantness that may be called logical were, beginning with the most indefinite, general sense of confusion, sense of something omitted, sense of a lack of equivalence between terms, clear idea of the omitted factors.

A second edition of Lange's *Die Gemütsbewegungen* (5) has appeared.

On the whole, the year was poor in valuable experimental results.


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# AFFECTIVE PHENOMENA—DESCRIPTIVE AND THEORETICAL

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A comprehensive critical review of work in the field of affective psychology during the ten years, 1900–1909, is given by Kelchner (7), who notices no less than 147 titles, all bearing on fundamental problems. This, not including the Italian literature, fairly represents the present lively interest in the subject. There is little to record of unanimity in results, and tendencies often seem more conflicting than converging. Four leading conceptions of the nature of feeling (including emotion) have been developed, with no agreement as to its criteria. Kelchner reviews the discussion of the peripheral theory *in extenso*, concluding that while the pathological evidence is ambiguous, investigations into visceral sensibility show that the theory is possible, while no observation obtained by the method of expression refutes its fundamental idea. As to the qualities of feeling, opinion appears on the whole to be against Wundt's tridimensional theory; it is suggested that the proposed new dimensions may be better characterized by relating them to moods than by comparison with simple feelings. A masterly analysis of the entire field of present discussion is also given by Külpe (8) in a paper read at the Geneva Congress in 1909. Külpe regards 'feeling' as an elementary mental state characterized by (*a*) universality of the stimuli,—anything can produce it, and (*b*) actuality,—it is always capable of being realized. These marks, he holds, are only found combined in pleasantness and unpleasantness; Wundt's proposed additions he takes as general sensations and the so-called intellectual feelings as conceptual marks of the object and general unanalyzable impressions. The admitted qualities are always identical, but may be variously classified as particular and general, active and passive, etc. The most noteworthy feature of Külpe's paper is his attempt to classify and analyze the various methods of investigating feeling. All are complex and relate as well to the production of the impression as to the subjective state of the observer. Külpe enumerates the elements of procedure in each group of methods, and finds, *e. g.*, no fewer than fourteen such particulars in the methods of registering the reactions. Experimentalists will take note of this analysis as both serving to re-establish synthetically the old and leading to new methods of research. The general nature of affective consciousness is also the

topic of the first of the articles in a volume by Ribot (16). Ribot's contention is that affective consciousness is of a totally different order from cognitive consciousness, being an expression of the organic, vegetative life. For this he offers evidence both direct and indirect, direct, *e. g.*, in certain experiences of pleasure, pain, fear, etc., which are devoid, or nearly so, of cognitive content, indirect, in the disappearance, or extreme enfeeblement, of one factor without the other. Ribot rejects Wundt's 'tension-relaxation' as belonging to the form rather than to the matter of the feeling, but includes 'excitement-repose,' which, as lying more in the region of the subconscious, affords, he thinks, a basis for admitting a 'state of indifference' intermediate between the pleasant and the unpleasant.

Another of Ribot's essays deals with the theory of pleasure, as does also that of Gardiner (4). Ribot's thesis is that pleasure is 'a higher form of normal life,' the normal state being affectively neutral. He traces its development through three stages,—euphoria, which is opposed, not to pain, but to dysphoria; pleasure determined by relation to an object; and pleasure as an exuberant activity. Nevertheless he rejects the theory which attributes pleasure to surplus vital energy and reverts to the older view of Aristotle, which makes it the accompaniment of unimpeded activity of tendencies. This is essentially the view reached by Gardiner as the result of a direct confrontation of ancient and modern theories. Pleasure, he holds, as expressing and furthering a function exercised in conformity with present tendency, is a sign of enhanced vitality, not, however, of the organism, but of the tendency and function.

The view that feeling is a unique mental element incapable of presentation and showing no tendency to ideal revival gives rise to the difficulty, or even denial, of 'affective memory' and, indeed, of understanding how feeling, as such, can be apprehended at all. The fact of affective memory, *i. e.*, of the revival of past affective experience with recognition of its pastness, is vigorously contended for by Ribot (16). His proofs are partly psychological,—comparison of past and present affective states (*e. g.*, the case of St. Preux), and the emergence of a feeling vaguely referred to the past and gradually becoming definite by reinstatement of the appropriate intellectual images; partly physiological,—it is incredible that the affective processes should always fail of revival when their intellectual concomitants are revived; partly pathological,—*e. g.*, nostalgia is often cured by a visit home, showing that the affective memory and the actual impression are distinct; partly indirect,—*e. g.*, the develop-

ment of 'general' emotions by repetition. It is, of course, not contended that the revived affection is visually imaged. Wodehouse (19), discussing the general question from the point of view of an adherent of Ward's doctrine, denies that it is imaged at all. She holds that any past experience can be apprehended in thought, as the subject of judgments, without repetition, either actual or make-believe, and that past feeling is, in this respect, in the same position as the presented elements of consciousness. The inference as regards present feeling is that we only know it "when our present act is to think of our present feeling." The whole difficulty appears to the reviewer to be largely fictitious. No one denies, even while declaring that feeling cannot be presented, that we are conscious of it; no one denies that feelings can be in some sense revived; and if it is maintained that such revived feelings are actual feelings, might not the same thing be said, with the qualifying explanations, of a visual or other sensory image? The truth seems to be that there is no such opposition of 'feeling' and 'presentation' as is presupposed, but only difference in the functional relationships of distinguishable conscious contents. The imperfection of our knowledge of our own feelings is well set forth by Ribot (16) in an essay on a form of affective illusion. We falsely judge their quality, genuineness, persistence, etc. This is explained as due partly to the impossibility, or extreme difficulty, of direct comparison, partly to suggestion, including auto-suggestion, but principally to the impossibility of knowing all the factors which determine the feeling, these being not only conscious, but subconscious and unconscious.

The doctrine that feelings are at once revived, individually experienced and yet 'represented' is an essential part of Prandtl's theory of empirical 'Einfühlung' (14). Prandtl criticises and rejects the imitation theory of Lipps in favor of a purely associationist theory, according to which, however, certain factors in the association, though present, may be unconscious. The usual order of the process he represents as follows: the visual perception of another's demeanor revives the idea of one's own similar appearance; this redintegrates the associated kinæsthetic and other organic sensations, and these reproduce the concomitant feeling, which is then, by a 'splitting' of the contents present, interjected into the other as the interpretation of the original perception. Considerable ingenuity is shown in explaining and defending this theory; but it may be questioned whether, in discarding all intermediation of imitation, any such explanation can be complete. Besides empirical 'Einfühlung,' in

which a feeling of mine is introjected into and terminates in another 'similar' object, the author treats of 'Stimmungseinfühlung,' in which my feeling does not relate itself to anything definite, but colors the situation while still felt as actually experienced by me.

The dulling of feeling is discussed by Martin (10), who finds no reason in the nature of adaptation why an agreeable emotion of moderate intensity should be dulled by repetition and regards it as improbable that painful or too violent emotions are dulled in this way alone. The conditions affecting dulling are, according to him, five: imaginative idealization of the object, surprise or expectation, fatigue, the need of enriching mental or emotional experience, and voluntary or involuntary attention.

To the psychology of the 'intellectual' feelings Piéron (12) contributes a brief paper of description and comment on a prolonged and repeated effort, finally successful, to recall forgotten names. The feelings in question are those of nearly attaining, of being balked, etc. The conclusion is that in a general way these 'feelings' appear to be sensations resulting from the cerebral dynamism facilitated (feeling of comprehension, recognition) or inhibited (feeling of novelty, obscurity, etc.), but that it is very difficult to verify this hypothesis.

The subject of the emotion is treated in a quasi-literary way by Rivari (17), who comments on the descriptions of fear, anger, etc., in Dante's *Inferno*. Three papers, among those under review, besides the previously mentioned article of Kelchner, deal with the theory of emotion. The problem of Tassy (18) is to account for the immediacy with which an emotionally exciting idea, *e. g.*, that of danger, connects itself with a specific organic reaction. He finds the solution in some original disturbance in the adaptation of the neurones concerned in ideation. Certain objects in virtue of their magnitude, unexpectedness, etc., set up reflexes in these elements which tend not to admit them. The object may be clearly represented later, the disturbance is directly represented and the organic correspondences, 'organic fear,' which the disturbance sets up are also represented. These three representations are associated. When, then, the object is again presented, the total association, if the memory of the disturbance is sufficiently intense, is revived. The idea of danger is acquired on the basis of the mental state thus mechanized. This accords with the peripheral theory, which Piéron (12) and Lapicque (9) consider as now definitely undermined. Piéron reports the recent experiments of Gemelli, who operated on two dogs and a cat, combining the methods of Sherrington, Bechterew

and Pagano, all of whose results were confirmed. But while the apæsthetized but non-decerebrated animal reacted normally to novel as well as to habitual stimuli, stimuli applied to the one that was both apæsthetized and decerebrated seemed to set up mere reflexes; moreover, when the *n. caudatus* of this animal was stimulated, the reactions showed no emotional phenomena, though normal in other respects. Piéron, admitting that he was wrong in formerly regarding the *n. caudatus* as the 'seat' of the emotion, since the cortex is here shown to be necessary, finds in these results evidence of the secondary rôle in emotion of the peripheral cœnæsthesia. Lapicque agrees with this, yet holds that the 'expression' forms an integral part of the total representation of an emotion. His theory of the process rests on a conception of discontinuity in structure and function of the elements of the organism, manifested in differences in the unit of time ('chronoaxia') required for effective response to stimulation. If the influx is of moderate intensity, the excitement, on the theory, passes to connected neurones of isochronous rate; if greater, to others that are heterochronous. It is only in the latter case that we have emotion. Emotion is thus regarded as due to a generalized irradiation, based primarily on intensity of stimulation, though this may come not from the initial stimulus, but from influences from other centres with which a given neurone or group of neurones is functionally related. A somewhat different irradiation theory is formulated by Bawden (1) and applied to the explanation of the comic. All emotional phenomena are held by him to be conditioned on an initial summation of stimuli, followed by an irradiation or discharge. The comic is connected with relatively abrupt relief from the tension accompanying the vigorous exploiting of habit-systems. The rudiment of æsthetic experience is accordingly found in primitive laughter.

Several studies besides Bawden's deal with specially named emotional states. De Fursac (3) treats of the passion of the miser, the essential elements of which he finds in exaggeration of the saving instinct and, negatively, atrophy of the affections and restricted mental activity. Hence whatever tends to weaken the former and, again, to develop the latter is unfavorable to the passion, and *vice versa*. These principles are then applied to the relevant facts. Two writers, Queyrat (15) and Ingegnieros (6) treat of curiosity. Queyrat's aim is practical. He distinguishes the forms of curiosity under such terms of appreciation as 'frivolous,' 'malign,' 'fruitful,' the interest culminating in a chapter on the education of curiosity. On the

psychology of the subject his work offers nothing new, no attempt being made to develop a genetic theory or to give a more intimate analysis of the conditions or expression of the sentiment, of its relation to pleasure-pain, to emotion and passion. The Spanish writer treats of it from the biological point of view as a functional expression of the tendency to adaptation, a form of originally useful reaction to the novel, and traces its evolution in animals, primitive man and children in its correspondence with mental development. The same point of view characterizes Ribot's study of antipathy (16), which is regarded as "an attenuated form of the instinct of conservation, acting by anticipation," and therefore as having a use in the preservation of the life of the individual, and, in its social forms, of the collective individuality of the group. Apart in this class of studies is Pfister's (11) examination by the Jung-Stekel method of free association and on the basis of the general assumptions of Freud's psychology of a case of suppressed hate and subsequent reconciliation, the subject and object of these feelings being respectively a boy of fourteen and his brother. The main conclusion about hate in such cases is that it gets imaginary satisfaction from images derived from the appropriate contents of actual or imagined experience, the injury desired being represented in the images as accomplished and the sexual component expressed in sadism or masochism. In reconciliation the earlier imaginations, possibly modified, are reinterpreted on the same or a sublimated functional level in accordance with the law of dreams.

Finally mention may be made of two papers dealing with certain pathological aspects of emotion. Hamilton (5), without resorting to artificial methods, such as dream-analysis, hypnosis, etc., learned from several of his patients facts which led to the conclusion that, in certain cases, neurasthenia begins in an unfavorable situation, or situations, not leading to satisfactory adjustment. His theory is that the affective tone of this state persists, giving rise to organic consequences made known to consciousness in terms of tension, and that the cardinal symptoms of neurasthenia—sense of fatigue, psychomotor inadequacy, etc.—are secondary effects of these organic consequences. Dugas and Moutier (2) discuss 'depersonalization' as essentially characterized by the loss or lowering of emotional tone, the exaggerated emotivity ascribed to certain subjects being, in either view, merely an expression of the romantic tendency to emotional make-believe. They distinguish it from an 'impersonalization,' in which emotion, owing to some organic defect, is habitually below the normal, as an emotional crisis, its factors being an emotion determining the

crisis, 'atony,' and the feeling secondarily aroused by its strangeness. While this last feeling causes distress, the atony itself is accompanied by repose. The detachment of the conscious states from the self cannot, in the opinion of our authors, be explained solely by the loss of emotion. The subjects have not lost personal consciousness, but a rupture has taken place between it and all of its states, the emotions appearing as illusory as the rest. The conclusion is that, while the loss of emotion is the characteristic and essential element which enables us best to comprehend the phenomenon, it only conducts us to the threshold of a mystery.

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## ATTENTION AND INTEREST

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The recent work on attention includes two books of general character, one by Arnold (2) the other by Vaschide and Meunier. The first is a summary of the known facts of attention with many applications to educational practice. In addition to the matter indicated by the title it treats subjects of such prime interest for the teacher as fatigue and the nutritive value of foods. The standpoint is a combination of the sensory clearness view with the motor theory. Attention is at once sensory clearness and a sensori-motor response. The other volume (8) is also a summary of fact. The first half is devoted to the methods of measuring attention and a brief statement of results. Of the methods most emphasis is put upon reaction times. The new contribution of the volume is a study of the ability to waken at a desired time. Thirty-four people undertook the experiment and all succeeded; the average error was about twenty minutes, and the tendency was to waken too early. No very definite notion of the mechanism of the process is given. The final section is devoted to a criticism of the motor theory and the statement of the authors' conclusions that attention is primarily affective in character, that it is a dynamic process and of central origin.

The greater part of the experimental work of the year centers about Wirth's method of measuring the distribution of attention. O. Lipp (6) repeated Wirth's experiments, using practically the same apparatus and methods. In general the problem was to determine the limen for brightness in different parts of the visual field, under varying distribution of attention. The results confirm those obtained by Wirth except in a few details. The central and lower portions of the field are favored under natural attention. The influence of attention is not clear. The author refrains from attempting to interpret his results on this point. A third contribution to the Wirth-Geissler controversy is largely given over to the discussion of the degree to which the earlier criticisms were the result of misunderstanding. Geissler (5) takes occasion to admit the existence of individuals

who have a consciousness of the multi-level type as regards clearness. Geissler still holds to his opinion that Wirth's method is too complicated and that it fails of the desired end.

Whipple (10) puts to experimental test the statement of Miss Aiken that it is possible markedly to increase the range of consciousness by training. The method used was to test the number of isolated letters or objects that might be appreciated during an .08 second exposure. Each observer was trained by from one to two hundred exposures and then tested again. The amount of improvement was very slight and is explained by the author as due to general habituation or to the development of particular habits of forming groups. Very interesting results for the general problem of the range of attention were obtained by the use of a three and six seconds exposure. It was found that only six objects could be appreciated during six seconds as compared with from four to five in the .08 sec. This seems strikingly to confirm the conclusion that in the shorter intervals reading is from the memory after-image. These experiments with longer exposures show as little effect of training as the shorter.

Knight Dunlap (4) reopens the problem of the complication experiment and finds a new solution for it as a problem in visual reactions. He noticed in some early tests with the complication apparatus that the pointer is ordinarily clearly seen at the moment a disparate stimulus is given. This led him to believe that in the usual form of judgment the eye was following the pointer. When a net was introduced between the eye and the pointer, the eye could be kept on one point and the pointer was blurred at the moment of observation. It was found that there was no constant error. This suggested that the constant error in the ordinary or natural fixation method is due to a reaction of the eyes from the point fixated to the pointer. The displacement is really the expression of a visual reaction time. Three types of results are distinguished dependent upon the method employed: (1) the exact fixation method which gives no constant error; (2) the pointer following method which gives positive errors, since the eye does not come to rest until a little after the stimulus is given and the scale divisions are not noted until the eye is at rest; and (3) the natural reaction method which gives positive or negative errors according as the rhythmic reaction of the eye is anticipatory or delayed.

Billings and Shepard (3) publish an investigation of the effects of attention upon respiration and pulse by a more accurate method

than has generally been used. Each pulse was counted separately and plotted with the respiration. This made it possible to trace the effect upon the pulse rate of respiration as well as of attention itself. The results show that the different functions are very closely interrelated. In visual attention respiration is decreased in amplitude but the rate is sometimes quickened, sometimes slowed; in auditory attention the rate is always slowed but the effect upon amplitude is variable. The heart rate is increased by strained attention. Increased breathing, either in rate or amplitude, increases the heart rate; decreased breathing checks the heart. In consequence, the restricted respiration due to attention often gives a slower heart rate, particularly in the first moments of attending. This slowed rate is to be explained from the inhibited breathing rather than from a direct influence of attention.

A theoretical discussion of another experimental problem, the attention wave, is offered by Wallin (9). Wallin insists that the recent arguments against the existence of the attention wave, the result of experiments upon minimal stimuli, will not hold against the fluctuations of a reversible perspective. Here the fluctuations are independent of the strength of the stimulus. Wallin suggests that while part of the problem may be referred to eye movement, some remnant is probably due to circulatory or respiratory rhythms. He suggests, in addition, that the phenomenon is possibly related to the refractory phase of the reflex-arc. It is like it, in that the period of reduced activity is longer than the period of increased activity, and in that the period is different for the different senses. It is urged that the theory be put to an experimental test.

Two general discussions deal with paradoxes of attention. Titchener (7) answers Woodworth's argument, that you could not compare clearness with lack of clearness, because one can not compare without attention and attention would make clear the unclear and so destroy the problem, with the statement that it is a fact that you can appreciate and pass judgment upon unclear states. It is argued that clearness is related to judgment just as are intensity or duration. Intensities can be compared without changing the intensity of the weaker stimulus, and in the same way a clear and an unclear process when in consciousness together, touch off a judgment without undergoing any change in clearness.

Alexander (1) insists that will and attention are mutually exclusive. The train of ideas can not be controlled by will, for if one knew what the idea was that it was willed to bring to mind it would

already be there and the willing would be unnecessary. Similarly, holding attention voluntarily upon an object always defeats its end; either one is distracted from the object to the attending itself or too complete attending produces mental vacuity. Objects become clear only by constantly passing from them to related objects and back again.


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# SPECIAL REVIEWS

## MIND AND BODY

*Der Einfluss psychischer Vorgänge auf den Körper.* ERNST WEBER. Berlin: Julius Springer, 1910. Pp. 1–426.

As implied by the title of this work Weber's main thesis is that the vasomotor changes which occur in connection with psychical processes are merely accompanying phenomena, and not, as held by the James-Lange theory, causally related to the psychical processes. The significance of the vasomotor changes consists in the longer duration of the psychical process which they make possible, in rendering the execution of the activity corresponding to the content of the mental process easier and in regulating the intensity of the latter. In support o this view a large amount of critical discussion and first-hand experimental evidence is presented.

Because of the possibility of the very general application of the plethysmographic method, and the relative certainty and definiteness of its results, the author preferred to confine himself chiefly to a study of the changes in the volume of the blood supply in various portions of the body under varying psychical conditions. Records of other motor changes, especially those of breathing, were taken, but mainly as checks upon the changes in blood pressure and volume. Subjects were chosen whose breathing movements were not easily influenced by the conditions of the experiments, and in many cases disturbing factors were eliminated by the use of hypnotic suggestion. The latter method was also used as a means of influencing the psychical processes in the desired direction. The range of the investigation, together with the chief results, may be seen from a study of the following table, in which + indicates an increase in the blood supply to the part named, and − a decrease.

| | Brain. | Ear. | Abdomen. | Limbs and External Trunk. |
|---|---|---|---|---|
| Movement ideas with or without performance | + | − | − | + |
| Mental work and increased attention | + | − | + | − |
| Involuntary attention and fright | + | − | + | − |
| Pleasure | + | + | − | + |
| Pain | − | − | + | − |
| Sleep | + | | − | + |

The opposite results occur under like conditions, in fatigue and pathological disturbances.

It will be seen from this table that Weber's main advance over the earlier work of this kind lies in his investigation of the conditions of the blood supply of the abdomen and of the outer portions of the head. The method used for the study of the latter was the fitting of a rubber capsule over the outer ears. The blood supply of the abdomen was investigated by the use of an 'inner plethysmograph' consisting of a rubber bag with tube attached. This bag was introduced into the lower intestine through the anus and slightly inflated. With the aid of an onkometer capsule a tracing was obtained showing changes in abdominal pressure, caused by variations in blood supply, due allowance being made for other factors.

A reference to the last two columns of the table will reveal the interesting fact that changes in the volume of the abdominal organs are always of an opposite character to those in the limbs and external trunk in the processes examined. This leads Weber to the conclusion that there is a reciprocal relationship between these two portions of the vascular system. He, therefore, believes the older view to be incorrect which held that there is reciprocal action between the cortical system of blood supply and that of the peripheral organs in such processes as increased attention and mental work. The apparent relationship is wholly accidental where it seems to hold and cannot apply at all in the case of agreeable and disagreeable feelings where the changes in brain and periphery are of the same general character.

Mosso's results with his tip-table cannot be explained as due to an increased volume of blood in the brain during mental work, for the brain being circumscribed by the skull, any increase in the blood supply must cause a withdrawal of cerebro-spinal fluid, leaving the net weight of the brain practically the same. The reason for the dip toward the head is rather the withdrawal of blood from the limbs and its influx into the abdomen, which in Mosso's experiments was placed mainly between the head and the center of gravity of the tilting system. Weber used a lengthened form of the tip-table and placed the subject upon it in such a way that the abdominal organs lay mainly between the feet and the center of gravity. Under these conditions the head end of the tilting board was raised rather than lowered during mental work.

Not only is there no necessary relationship between the cortical and peripheral blood supply but the two systems are governed by independent nerve centers. By stimulation of the appropriate nerves

in cats and dogs the author was able to vary the blood supply of the brain without any corresponding changes in the general blood supply taking place, and as these effects remained after destruction of the vasomotor center in the medulla, the conclusion was drawn that the center for the control of the cerebral blood supply lies centrally from the medulla. Furthermore, drugs such as alcohol were found to have different effects upon the brain from those in other parts of the body, thus confirming the supposition of their independent control. In these experiments both hemispheres participated in the changes in volume even when the nerves on only one side of the body were stimulated.

The relation of blood supply to movement was studied in two ways. In the first place, the motor cortex of cats, rabbits and dogs was electrically stimulated and the effect on the blood supply noted. It was found that such stimulation always brought about an influx of blood, but that the region of the brain in which the blood vessels were thus distended varied in the different species of animals. Simultaneously there was increased blood supply to the parts of the body concerned in the movement. In human subjects analogous results were obtained. Both in making actual movements and in thinking of movements, the volume of the brain and also of the arm or leg, to which the movement was referred, increased. The significance of this flow of blood to the brain lies, thinks Weber, in the replenishing of the cortical and muscular cells concerned in the movement, thus making possible the performance of the activity for a longer period and with greater ease.

It is not so easy to discover the significance of the changes in the distribution of the blood taking place in pleasure and pain. Weber believes that they are related to the processes of assimilation and dissimilation in both cortical and muscular cells. The constriction of the blood vessels in both regions under conditions of unpleasant stimulation leads to less rapid dissimilation and decreased sensitivity to the disagreeable stimulus, the rapid dissimilation having performed its function the moment the disagreeable feeling comes to consciousness.

The withdrawal of blood from the peripheral organs and its influx into the abdominal organs during mental work leads to a decreased sensitivity of the former, thus counteracting tendencies towards distraction of the attention. Cases are presented which show that this withdrawal is greater in difficult than in easy mental work.

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## TIME AND FREE WILL

*Time and Free Will. An Essay on the Immediate Data of Consciousness.* HENRI BERGSON. Authorized translation by F. L. Pogson, M. A. New York: Macmillan, 1910. Pp. xxiii + 252.

The present volume is peculiarly difficult of detailed appraisal. It is not its special assertions so much as its whole point of view—its speculative technique, so to speak—that calls for first inspection: and, according to one's verdict about it, will Bergson's entire architecture be proved or discountenanced. What you think about introspection, you will think about Bergson; and, if you rate the method low, he has nothing to say which will better your opinion of it. The volume is an attempt to show, through introspective critique, the naturalness and also ineradicable error of every mechanistic, mathematical interpretation of mental life, including psychophysics. The first move is toward demonstrating that, contrary to supposition, psychic states have no quantity; and the first point to be made is that there is no such thing as *a* sensation with greater or less intensity; for intensity is not a disguised quantity, but a unique quality. If we remain loyal to the introspective method, we must say that there are as many different and irreducible sensation qualities as there are distinguishable intensities.

If this demonstration fails, Bergson's entire system must be revised; for it is the mainstay of his wider doctrines.

It becomes apparent, in the very first pages of the book, that Bergson has no notion of any other criterion of existence save that of awareness. "We call that space the greater," he says, "which contains the other. But how can a more intense sensation contain one of less intensity?" Now, this question plainly presupposes that, *if* the lesser intensity is contained in the larger, it must be felt *as so contained*. He says: "The question, then, is how we succeed in forming a series of this kind (like the cardinal numbers) with intensities, *which cannot be superposed on each other. . . .*" And, on the following page: "If we call that which contains the other the greater quantity, why go on speaking of quantity and magnitude, when there is no longer a container and a contained?" Can anything be plainer than Bergson's preconviction that the mathematical criterion is subject to the introspective? For, when he declares that there is, in *qualia*, no container and no contained, he assumes that if you do not sense the container and the contained *as such*, they do not exist. In short, Bergson's position is fundamentally Berkeley's. To his

way of thinking, it is a pure contradiction that a *quale* should increase in intensity without our immediately perceiving within it, absolutely unmodified, both the lesser and the greater intensity. To this we may retort that, after all, his first concern should have been to find some reason for accepting such a strange, unnatural test of reality.

The hypothesis has embarrassments, to all of which he seems quite oblivious.

In what does our perception of intensity exactly consist? Bergson's answer runs thus: "The more a given effort seems to us to increase, the greater is the number of muscles which contract in sympathy with it; . . . the apparent consciousness of a greater intensity of effort at a given point of the organism is reducible, in reality, to the perception of a larger surface of the body being affected." This is his general explanation of all 'apparent' intensities; the activity involved with the unextended psychic state radiates through the body, and a great mass of secondary induced *qualia* fuse in and around the primary *quale*, which fallaciously becomes, as it were, the subject of which they are attributes. But by what right does Bergson here reject his Berkeleyian criterion, which he has used to establish the difference between quantity and quality? We have seen above that he tests the existence of quantity by asking whether he can immediately perceive a container and a contained. Why does he not test the existence of intensity in the very same way? Why does he not say that, if you perceive a certain effect as a quantitative increment of another, this introspective evidence is conclusive of its being so? We directly experience one red as brighter, though still the same red; one flavor as sweeter, though still the same acid; one pleasure the more intense, though still the same quality. Why shall we pronounce this illusory, and yet hold that our perception is *not* deceptive when we fail to find a container and a contained? It is not enough to point out that the field of motor reaction enlarges and induces secondary sensations; for this proves absolutely nothing against the genuineness of intensity increments, inasmuch as these secondary sensations may somehow induce internal quantitative changes in the initiating quality. And there are many more such logical possibilities: as for instance, that the radiation and consequent induction of secondary sensations may be an effect of increased intensity in the initiating quality, precisely as the spread of a magnetic field and its heightened efficiency (measured in terms of any chosen unit) is induced by an intensification of an electric current. But, be the facts what they are—and we know precious little about them!—

over and above them towers the purely logical issue: why does Bergson here refuse the immediate testimony of introspection and appeal to a rare difficult sort, in his attempts to interpret all intensities as constellations of blending qualities, while, in the case of deciding the presence of quantity, he rests his whole case upon naïve impressions? His writings contain no answer.

The second, and, on the whole, the graver difficulty is this: Bergson's general hypothesis compels him to adopt a theory about the serial ordering of qualities which implies an unbelievable physiology. Consider the case of the tonal system. Are the differences in perceived pitch quantitative? No; the higher note is simply the one which taxes the more severely your tensor muscles of the vocal chords, when you attempt to produce it; and sometimes it is the note which resonates in your thorax, instead of in your head, as the high notes do. Once more let us waive an awkward question; this time about the way we know that tensor muscles are exerting a 'greater' or 'less' effort, and what this 'greater' or 'less' is (whether it is the pure number of induced qualities or a quality of the congeries itself). Let us consider only the general proposition that somehow the greater intensity, the higher pitch, the brighter light, the louder sound all owe their supposedly intensive character to the number and location of the induced sensations. What does this imply? Plainly that, just in proportion to the stability and definiteness of a quality-system, is the induced sensation congeries of each individual sensation fixed and constant. Thus, I am compelled to say that the tone C lies between B and D because C's induced fringe lies between those of B and D. *But how do I know that the fringes are so related?* What is there in one complex of supposedly pure qualities which forces me to judge that one must be interpolated between two others and *only between these particular ones?* Neither jointly nor severally can the pure qualities, as Bergson regards them, give this notion of betweenness, for each is completely non-spatial and non-quantitative. Bergson may explain each single intensity as being only a mass effect of a fringe; but this carries him not an inch toward explaining the rigid order of the tone series (and many others) *unless he also assumes that each fringe is invariable throughout a person's life and that he somehow senses the number or the patterning of the fringe elements.* The first assumption involves, as anticipated, an incredible view of physiology; the second assumption entails a belief in subconscious or else undefined perceptions,—a belief which, as we have seen, Bergson will not tolerate when it is a question of perceiving quantity but welcomes under other circumstances.

Bergson's mathematical prepossessions get the better of him in his exaggerated opposition between quality and quantity. Speaking as an introspective psychologist, he ought to say that perceived spaces are qualitatively different from one another. Now, in his chapter on Space and Homogeneity (p. 96 ff. especially), he recognizes this fact in animals. They, he asserts, sense directions as peculiar qualities. We have a vestige of this capability left us, in that we distinguish right from left by just such a natural feeling; "this," he adds, "is the very reason why we cannot give a proper definition of right and left." But the space which we construct out of non-spatial qualities is a "reality without quality," "an empty homogeneous medium," "a kind of reaction against that heterogeneity which is the very ground of our experience." We cannot hope here, to give this opinion the careful attention it deserves. Dogmatically, then, be it said that, in the reviewer's opinion, Bergson has not emancipated himself from a mathematical-geometrical convention, and with the result that his entire psychology and metaphysic are one prolonged struggle to explain a problem which, in reality, does not exist at all. The convention I allude to is that which asserts that 'pure space' consists in the absence of every quality. The meaning of this proposition evidently varies with the connotation of the term 'quality'; but, taking Bergson's own antithesis between quality and quantity, it means either that 'pure space' has no dimensions and no directions, or else that dimensions and directions are not qualities, but rather quantities! The absurdities of each alternative must be patent. We escape them, not by stripping space of all character, as Bergson does, but rather by conceiving it as actually having all directions and all dimensions. Instead of being immeasurably poorer than perceived space, it is infinitely richer; in it we can conceive differences of direction which perception can never yield, and dimensions beyond all the senses. It is, then, the perceived space which is the fragmentary cluster of qualities; as it were, loose tracts, chance streaks in real space which we sense.

The pervasive defect of these, Bergson's earlier studies, seems to root in psychological atomism, which is the very notion he means to oppose. This tendency is apparently connected with the very effort to attend to 'mental states'; perhaps it must condemn the introspective method altogether. If so, all of Bergson must be discarded. But, in any case, Bergson's introspection has landed him squarely in the old-fashioned doctrine of mental elements which can be brought into relation only by an act of the mind, which is precisely

and consciously the Kantian synthesis. "All unity is the unity of the simple act of the mind," says Bergson; and the mind has quite a chore getting the parts of such a unity together. "In order to get a number, we are compelled to fix our attention successively on each of the units of which it is compounded." Likewise, in time perception; "succession exists solely for a conscious spectator who keeps the past in mind and sets . . . symbols side by side in an auxiliary space." (In passing, we may observe how utterly different this Kantian psychology of Bergson's is from William James's 'radical empiricism,' whose feelings of 'and,' 'but,' 'along with,' and all the rest are precisely as immediate as reds and greens. And yet, these two philosophers honestly believed they agreed in their doctrines of percept and concept!)

It is a pity that Bergson has employed such means to found his profound hypothesis of real duration and indeterminism, which has actuated the writing of this book. That real time cannot be expressed in terms of space is a truth, the insistence upon which has made Bergson justly famous. Of equal importance is the corollary that the determining conditions of real action are immanent in the actual course of the action itself, and not capable of reduction to formal external factors. One of the great chapters of philosophy is the third in *Time and Free Will*, where Bergson beautifully demonstrates that to know completely the antecedents of an action is to be actually performing it, and that therefore the usual dilemma between determinism and indeterminism is meaningless, because each horn of it treats feelings and knowing processes as capable of being abstracted from the course of living conduct in which they arise and where they are genuinely efficient. To save the reality of space, in one manner or another, many philosophers have virtually abolished time. In this respect, oddly enough, Hegel and the ordinary natural scientist, with his mechanics of an 'empty' time, are alike. Bergson establishes the rich reality of time, but, alas! thinks it can be done only by virtually eviscerating space! Some day, perhaps, philosophers will not maltreat either.

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## BOOKS RECEIVED DURING APRIL

ELLIS, H. *The World of Dreams.* Boston & New York: Houghton Mifflin, 1911. Pp. xii + 288. $2 net.

LOSACCO, N. *Razionalismo e misticismo; saggi e profili.* Milano: Lib. Edit. Milanese, 1911. Pp. 259. L. 3.50.

OLINTO, P. *Contribuiçao ao estudo da Associaçao das ideas.* Rio de Janeiro: Besnard Frères, 1910. Pp. 80.

VAN BRUYSSEL, E. *Le mal et ses origines.* Paris: Giard & Brière, 1911. Pp. 216. 2 fr. 50.

BOHN, G. *La nouvelle psychologie animale.* Paris: Alcan, 1911. Pp. 200. 2 fr. 50.

DUPRÉ, E., & NATHAN, M. *Le langage musical.* Paris: Alcan, 1911. Pp. 195. 3 fr. 75.

D'ERCOLE, P. *Il saggio di panlogica ovvero l'enciclopedia filosofica dell'hegeliano Pietro Ceretti, I, II.* Torino: Bocca, 1911. Pp. xvi + 513, 640. L. 12.

BAJENOFF & OSSIPOFF. *La Suggestion et ses limites.* (Coll. de Psychol. Expér.) Paris: Bloud, 1911. Pp. iv + 117.

ABRAMOWSKI, E. *L'Analyse Physiologique de la Perception.* (Coll. de Psychol. Expér.) Paris: Bloud, 1911. Pp. iv + 120. 1 fr. 50.

PEREGRINUS, M. *Litora Aliena.* Boston: W. M. Leonard, 1911. Pp. 77. $0.50.

"JUSTUS." *Prolegomena to Theism.* New York: Andrew H. Kellogg Co., 1910. Pp. 70.

WELLS, F. L., & FORBES, A. *On Certain Electrical Processes in the Human Body and their Relation to Emotional Reactions.* (No. 16 of Archives of Psychology.) New York: The Science Press, 1911. Pp. 39.

## NOTES AND NEWS

THE Eighth Meeting of Experimental Psychologists took place at Ithaca, April 17–19, on the invitation of the department at Cornell University.

THE New York Branch of the American Psychological Association met on April 24th in conjunction with the Section of Anthropology and Psychology of the New York Academy of Sciences.

THE First International Congress of Paidology will be held at Brussels during the third week of August. The announced object of the Congress is to coördinate, in the interests of education, the various results reached by the scientific study of the child.

THE following items are taken from the press:

DR. EDMUND B. HUEY has resigned his position as clinical psychologist to the Illinois state institution for the feebleminded at Lincoln, Illinois, to continue clinical research at the Johns Hopkins Hospital and in the city of Baltimore.

MISS LILIEN J. MARTIN has been advanced to a professorship of psychology at Stanford University.

## EDITORIAL NOTE

THE editors of the PSYCHOLOGICAL REVIEW will welcome information as to omissions or inaccuracies in the List of Published Writings of William James which appeared in the March number of the REVIEW. It is requested that such information be addressed to Mr. Henry James, Jr., 95 Irving St., Cambridge, Mass. After sufficient time has elapsed to insure the completeness of the data the REVIEW will publish a supplementary list. Offprints of the bibliography have been sent to all members of the American Psychological Association. Those who are interested and have not received a copy may secure one by writing to Professor H. C. Warren.